of river, which is about 2 feet 9 inches above summer low-water level.

Yours truly,
WILLIAM BOWEN

The pier master (W. Mants) at Clevedon, near Weston-super-Mare, reports that he timed the rise of the tide there on March 10 from two hours flood, and found that it flowed thirty feet perpendicular in two hours and forty-five minutes. On March 24 the tide rose thirty-eight feet at the Clevedon Pier Head.

J. Y.

Ice Pearls

A PHENOMENON of singular beauty presented itself on the morning of March 24. A patch of meadow land, several acres in extent, had been inundated so far as to leave, pretty regularly distributed throughout, stalks of last year's grass projecting several inches above the surface of the pond. During the preceding night the temperature had been below freezing-point, but the wind which rippled its surface prevented the pool from freezing, while it alternately raised and depressed the stalks of grass. The water thus collected by the bending and rising grass-heads formed into large shining beads of ice which lay at the point of junction of the stalk and the pool. The effect was as if each projecting stalk had unfolded a white flower floating on the water, and when a gleam of sunshine smote the surface of the pool, the effect was resplendent.

J. SHAW

Tynron, Dumfriesshire

Unscientific Art

MR. COPPOCK'S explanation (NATURE, vol. xix. p. 484) has occurred also to me; but may I be allowed to remind him that in consequence of the internal construction of the marine barometer (the pipette and the contraction in the tube), when it is sloped the mercury rises and falls very slowly. As it naturally rises and falls at a decreasing rate, if the barometer be sloped for a few seconds it takes a comparatively long time for the mercury to resume its original position. I have just sloped one of Adie's marine barometers at 30° from the vertical, and I find it takes more than ten minutes to recover itself. I do not know what may be the actual practice on board ship, but I cannot but think that a plan which renders a barometer useless for ten minutes to another or the same observer must be an unusual one.

JOHN W. BUCK

New Kingswood, Bath, March 28

SCIENCE AND WAR—SIGNALLING BY SUNSHINE

THE use of the heliostat in the field adds one more to the many applications of science made by our soldiers and sailors. Signals by sunshine may be no novelty, but the present Afghan campaign and the Zulu war will henceforth be cited as the first in which the heliostat was employed as an implement of warfare. There can be little question as to its value to the soldier, for it affords at once a ready and far-reaching mode of signalling; but sunshine is an obvious *sine quâ non* to its use. In this country, where the Astronomer-Royal tells us the number of hours of sunshine in the week sometimes does not go beyond the units, the heliostat would furnish but an irregular means of telegraphing, and interruptions in the service would be both frequent and prolonged But in India, on the other hand, at special seasons, at any rate, sunshine is the rule rather than the exception, and consequently the heliostat furnishes an excellent means of communication which our scientific soldiers have done well to make use of.

Heliostat stations are established at this moment throughout the Khyber Pass, and General Sir Sam. Browne, at Jellalabad, has his orders passed up to him by flashes of light from Peshawur and Ali Musjid. Lord Chelmsford has of late also been furnished with heliostats, in order to provide him with better means of communication along the Tugela. The plan of working is very simple. The mirror of the heliostat is placed so as to reflect the sun's image to a distant station, and when the instrument has once been set the clockwork arrangement, it need not be said, suffices to maintain the mirror in its proper position. In this way the distant station in question always sees the dazzling ray reflected from the mirror, except when the latter is purposely obscured. The appearance and disappearance of the bright spot or flash constitute the signals. There is no need for any superintendence when once the apparatus has been put in working order, and a trained signalman suffices for the duty. The ordinary Morse alphabet supplies an intelligible code, and no one out of the line of signals can read or understand the message. As a substitute for the dot and dash, which go to make up the ordinary written Morse code, the light is shown for short and long intervals; thus the light shown for a short period followed by a long period signifies A, while B is represented by a long period followed by three short ones; in the case of C, long, short, long, short signals are made in turn, and to form E, the letter most frequently used, the light is permitted to shine for one single short period only.

The intensity of these sunshine signals can scarcely be imagined by any one who has not seen the heliostat in working order, and the distance to which they might be made to travel, could suitable stations be provided, is practically unlimited. But everybody has noticed at one time or another, just before sunset, the light striking vividly against the windows of a house. In this case the burning spot may be seen for miles away, and forms the most striking object in the whole landscape. The heliostat signal is obviously brighter still than this, and the appearance and non-appearance of the light is to be appreciated at ten or twenty miles distant without the aid of telescope or binocular.

Signalling by the aid of a mirror is among the earliest experiments of telegraphy, nor, if we are to believe travellers, is the use of a reflecting surface in this way new in warfare; it is only the heliostat, indeed, which we can claim to have been the first to employ in the field. Several instances are on record of polished metal surfaces being used in this manner by savage nations, and it is but two years ago that the United States forces captured a tribe of Indians to whom the use of the mirror was not unknown. These were the Nez Percés Indians, and, according to latest accounts, they were still confined by the American Government in a camp near Fort Leavensworth, where, however, they were left pretty well to their own devices. According to the *New York Daily Graphic* their chief carried with him a looking-glass, "used to direct military manœuvres in battle, by means of reflected rays of light. Their various significations, however, have never yet been found out by the white man," we are told. These are not likely to have been very complicated. The difficulty, in fact, is not so much in reading light-signals of this kind as to reflect the rays in precisely that direction in which the party for whom they are intended happens to be located. How the chief of the Nez Percés managed to do this with his hand-mirror is rather what "the white man" would like to understand.

One other incident in the history of light-signals deserves to be mentioned. When Admiral Sheriff was stationed at Gibraltar in 1835, he made a series of experiments with a view to employing light as a means of telegraphy. His signals were made by an ordinary toilet looking-glass from his bedroom window, that looked out upon the Mediterranean, and by the aid of this simple apparatus he was enabled to communicate with a friend at Tangiers. His light-signals travelled from "the Rock" right across to the African mainland, a distance of something like twenty miles, and were read and answered without difficulty by his colleague on the opposite shore.

Besides the heliostat, our troops in the field are provided with flags and lamps for signalling by day and night. The flags are made four feet square, so as to be

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visible at some distance, and they are white or black, to be used according to circumstances; moreover, the signalmen are furnished both with binoculars and telescopes to enable them to read the signals from remote stations. At night either a bright colza light is made use of, or a spirit flame, into which is blown from to time a mixture of powdered magnesium and resin. A short puff or a long puff constitutes short and long signals, which are displayed, as before, in accordance to the Morse code. Every battalion of infantry and regiment of cavalry in the British army has a proportion of its men trained as signallers, so that these can act at once on taking the field. Their duty is to communicate between outlying pickets and the fighting column, and to do duty where there is no telegraph. For let the field telegraph of an army be ever so well ordered, there is always plenty to do for the army signaller; and he will doubtless find in the heliostat a means of fulfilling these duties with increased efficiency.

H. BADEN PRITCHARD

FLOODING THE SAHARA

THE French scheme of turning part of the Algerian Sahara into an inland sea continues to attract considerable attention in France, and scarcely a week passes without some allusion being made to it in the Paris Academy. At a recent sitting M. de Lesseps read a letter from Capt. Roudaire in which the latter gave some details of the results of his sounding of the soil at various points, sands and marls being the beds most commonly met with. At one place, four metres below the surface, plenty of potable water was met with, which will be a great saving in carrying on the work.

At the same sitting MM. Ch. Martens and Ed. Desor presented several considerations against carrying out the plan, their opposition to it being shared by several other French men of science. They have themselves examined part of the ground which it is proposed to put under water, so that their opinions ought to have some weight. While giving every credit to M. Roudaire for the accuracy of the survey which he is carrying out, they, however, point out the difficulty of perfect accuracy, which in this case is all important, in the classic country of mirage, where the surface of the ground is constantly altered and deformed by reflection and refraction. Moreover, they point out that to the south of the projected sea is the Wed-Souf, where are ripened the dates known as Tunis dates, the culture of which is a very special one. The least error in surveying, it is shown, might lead to the destruction of this culture, by allowing the waters of the Mediterranean to penetrate the soil where the date-trees are grown, and thus destroy them. The authors do not attempt to touch the argument that even in historical times part of the Sahara now being surveyed was really a great lake; but they point out that there are proofs that in prehistoric times there must have existed an interior sea, at an epoch when the hydrographical conditions of Europe were very different from what they are now. In 1863, when exploring the region between the oases of Guemar and the south extremity of the Shott Mebrir, they found the gypsum beds of the plateaux ended in regular lines like sedimentary beds, and from the soil they collected the *débris* of shells, truly marine, such as *Buccinum giberrulum*, Lam., and *Balanus miser*, L. Above these shells, in the sand, they found *Cardium edule*, better preserved than they had ever seen it. Thus they found fossils characteristic of salt water, and of those which are a mixture of salt and sweet. The retirement of the waters from the Sahara the authors attribute to the elevation of the land, which is even yet below the level of the Mediterranean, and is to a great extent a network of salt lagoons.

It has been said that the creation of an interior sea, of 13,280 square kilometres, would change the pluviometric condition of the country, and even that of the whole of Algeria. This MM. Martens and Desor regard as a great illusion. Although the laws of the general atmospherical movements are little known, yet it is admitted that the Atlantic is the great reservoir from which come the vapours which are resolved into rain over the European continent. They believe that this is also the case for Africa. The Mediterranean is really only a Gulf of the Atlantic, and they do not believe that an addition of 13,000 kilometres will add anything to its climatic influence. Long calculations have been made as to the quantity of water that would be evaporated by the new sea; but the authors point out that the predominating wind in the region is north, and that if it were rendered either too cold or too moist it would injuriously affect the date-culture carried on in the south. The surroundings of interior seas, like the Caspian and Aral, are steppes noted for their aridity; the shores of the Mediterranean suffer in the same way when, as last year, the rains of the north do not extend to the south. For these reasons MM. Martens and Desor think it would be a mistake to insist on the creation of the interior Saharan Sea.

In a subsequent sitting, however, it should be said, M. Favé endeavoured to show that their fears were groundless, especially with regard to the accuracy of the survey; he thinks that the work in connection with the Suez Canal showed that perfect confidence may be placed in the methods of surveying adopted.

THE LONGEST TUNNEL IN THE WORLD

SCHEMNITZ, the principal mining city of Hungary, has celebrated the opening of the Joseph II. Mining Adit, the deepest gallery of efflux of that place, and the longest subterranean work of this kind in the world.

Its excavation was commenced in the year 1782, during the reign of the Emperor Joseph II., whose name it bears, and has been continued since that time, but with varied energy. The most rapid progress was made within the last five years, so that its completion on September 5th, 1878, was a kind of surprise, and was saluted by guns, which caused a great joy in the city, because it announced a new era for the mining operations of the whole district.

Works of such importance deserve to be installed with solemnity, and a festival was arranged for the purpose on October 20-22, 1878. Prof. Szabó, one of the guests from Budapest, delivered a report to the Royal Hungarian Society of Naturalists, as a representative of that body, and we shall not hesitate to communicate an extract of this.

As the mining operations were progressing in depth, there was at the same time a well regulated system of sinking shafts and driving tunnels employed. The Joseph II. Adit is the eleventh of that kind; it lies 200 metres deeper than the Francis Adit, which was until now the principal gallery of efflux for the mines of Schemnitz. This was excavated between the years 1494 and 1637 to a length of 1,968 metres; but a greater extension was given to it by continuing the works from 1747 till 1765. After this period the mines of Schemnitz proved to be so lucrative, that the idea of undertaking some greater work for securing the future prosperity of the mines was conceived, and so the plan was fixed of driving a tunnel at the deepest possible level, which could convey the waters to the valley of Gran, the lowest point indeed which could be obtained within a practicable distance.

They commenced boring the tunnel west from Schemnitz, near the village of Voznitz, on the left bank of the Gran. The height of it is three metres, the width 1·6 metres. About the lower third is destined to convey off the waters, while the upper two-thirds are separated from this by a platform, and adapted for transporting the ores.

According to the original plan it could have been finished in thirty years at the cost of 1,215,000 florins.

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